Evaluations of New Turfgrass Fertilizers: Field and Laboratory Studies

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Objectives:

1. Evaluate new fertilizer chemistries for their effect on turfgrass performance.
2. Compare these new fertilizers to standard soluble (ammonium sulfate and urea) and slow release (polymer–coated and methylene urea) programs.
3. Examine the performance of these materials as a function of: 1) season, 2) grass, and, 3) soil type.

In Table 1, the products listed were evaluated (or will be evaluated) in a series of field studies and in laboratory incubation and volatilization studies. Results provided in this preliminary study are from two spring/summer field evaluations and the first run of a laboratory volatilization experiment. Not all products have been tested at this point, and some products may not be tested. For example, the NutriLife people were not all that interested in providing product. We are attempting to get the product for testing.

Field studies were initiated at the Auburn University Turfgrass Research Unit (TGRU) in May, 2013, with the application of the various N sources. Not all N sources were applied in every test, and additional N sources will

Table 1. New turfgrass fertilizer products to be tested.

Product (Trade name)	Additive (if known)	Purported benefit as compared to a ´typical´ soluble N source
Stay N (or NZone or NStay)	Ca–aminoethylpiperazine and Ca–heteropolysaccharides	Volatilization inhibitor, nitrification inhibitor
Hydrexx	NBPT (N–butyl thiophosphoric triamide) and dicyandiamide	Volatilization inhibitor, nitrification inhibitor
UFlexx	NBPT (N–butyl thiophosphoric triamide) and dicyandiamide	Volatilization inhibitor, nitrification inhibitor
UMaxx	NBPT (N–butyl thiophosphoric triamide) and dicyandiamide	Volatilization inhibitor, nitrification inhibitor
Nutrisphere	maleic–itaconic polymer	Nitrification inhibitor
Harness	Unknown	Enhanced longevity of color response
Instinct	Nitrapyrin ^	Nitrification inhibitor
NutriLife	Mixture of natural occurring microorganisms in water (bacteria including Bacillus spp.) with humic substance.	Enhanced longevity of color response, increased fertilizer use efficiency
Nitamin	Unknown	Nitrification inhibitor
Nitamin Fusion	Unknown	Nitrification inhibitor

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be applied in the fall studies and in the 2014 work. Two field studies were conducted: 1) fertilizers applied to Tifway hybrid bermudagrass maintained at fairway height, and 2) fertilizers applied to Penn G–2 creeping bentgrass applied at putting green height.

Bermudagrass – Field Trial

For the bermudagrass test the fertilizers were first applied on May 20th, 2013, and they were reapplied on August 1st, 2013. Applied products were: 1) urea – granular, 2) urea – liquid, 3) UMaxx, 4) UFlexx, 5) Hydrexx, 6) urea + Instinct, 7) Harness, 8) Nutrisphere, and, 9) urea + Stay–N. Treatments 2, 5 and 7 were applied as liquids using a backpack CO2 sprayer. Treatments 6 and 9 had those products applied to urea granules, with the granules then applied to the turf. It should be noted that that method of treatment was incorrect for Treatment 6, as the Instinct should have been applied separately as a spray across the turf at the same time as fertilizer application. This is an experimental treatment, and in future work we will likely include both methods of applying the Instinct. All other products were applied as granular materials.

Table 1. Relative color (1–9 scale) of Tifway hybrid bermudagrass as affected by fertilizer additive or fertilizer source, Auburn, AL 2013. All fertilizer applied at 1 lb N per 1,000 square

Additive or Fertilizer	Hours or days after initial fertilization										
	48 hr	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days	70 days
	Relative color (1 – 9 scale)										
Urea Gran	3.5 a	8.3 a	7.5 abc	7.5 ab	7.5 a	6.5 c	7.3 abc	5.8 a	6.0 a	5.3 abc	5.5 ab
Urea Liq	4.3 a	8.3 a	7.3 bc	6.5 bcd	6.0 b	5.8 d	6.5 cd	5.8 a	5.8 a	4.8 c	4.0 bc
UMaxx	4.0 a	8.8 a	8.0 ab	8.0 a	7.0 ab	7.8 a	8.0 a	7.3 a	5.8 a	5.0 bc	4.8 abc
UFlexx	3.5 a	8.5 a	8.5 a	8.0 a	8.0 a	7.5 ab	7.8 ab	6.5 a	5.8 a	5.3 abc	5.3 ab
Hydrexx	4.3 a	7.8 a	6.5 c	6.3 cd	6.8 ab	5.3 d	6.3 cd	6.5 a	5.8 a	5.8 abc	5.0 abc
Instinct	3.5 a	8.8 a	7.8 ab	8.3 a	7.8 a	6.5 c	6.8 bcd	6.8 a	5.8 a	6.0 abc	5.0 abc
Harness	4.0 a	5.5 b	4.5 d	5.5 d	6.0 b	5.5 d	6.0 d	7.0 a	5.3 a	6.5 a	5.8 a
Nutrisphere	3.5 a	8.3 a	7.3 bc	7.3 abc	6.8 ab	6.8 c	6.5 cd	6.0 a	6.5 a	6.3 ab	5.0 abc
Stay–N	3.8 a	8.5 a	8.0 ab	8.0 a	7.3 ab	7.0 bc	7.0 abcd	7.0 a	5.8 a	5.5 abc	4.8 abc
Control	2.3 b	2.5 c	2.0 e	2.0 e	2.8 c	2.0 e	2.8 e	3.3 b	3.0 b	3.5 d	3.5 c
	Days after second fertilization										
	4 days	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days	
	Relative color (1 – 9 scale)										
Urea Gran	8.5 ab	8.5 a	7.5 ab	7.3 bcd	6.3 abc	7.5 ab	6.8 ab	7.0 ab	6.0 ab	6.0 ab	
Urea Liq	8.5 ab	6.5 c	5.8 d	6.8 cd	5.8 bc	6.0 c	6.0 b	6.3 ab	5.0 b	5.3 b	
UMaxx	8.0 ab	8.0 ab	8.0 a	7.5 abc	6.0 bc	7.0 abc	7.0 ab	6.8 ab	5.0 b	5.3 b	
UFlexx	8.8 a	8.5 a	7.8 a	7.8 ab	7.0 ab	7.8 a	7.8 a	7.3 a	6.8 a	6.5 a	
Hydrexx	8.8 a	7.3 bc	6.8 bc	6.8 cd	6.0 bc	6.8 abc	6.3 b	5.8 b	5.3 b	5.3 b	
Instinct	7.8 b	8.8 a	8.3 a	8.3 a	7.5 a	6.8 abc	7.0 ab	6.5 ab	4.8 b	6.0 ab	
Harness	8.8 a	6.3 c	6.0 cd	6.5 d	5.5 c	6.3 bc	6.5 b	6.0 ab	5.0 b	5.8 ab	
Nutrisphere	8.0 ab	8.0 ab	6.8 bc	7.5 abc	6.5 abc	6.5 abc	6.8 ab	6.8 ab	5.3 b	5.0 b	
Stay–N	8.0 ab	8.0 ab	8.0 a	7.5 abc	6.8 abc	6.8 abc	6.8 ab	6.5 ab	5.8 ab	5.8 ab	
Control	2.5 c	2.3 c	2.3 e	3.0 e	2.3 c	3.0 d	2.5 c	2.8 c	2.3 c	2.8 c	

Within each rating date, means followed by the same letter are not significantly different from each other at alpha = 0.05.

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Table 2. Relative quality (1–9 scale) of Tifway hybrid bermudagrass as affected by fertilizer additive, Auburn, AL 2013. All fertilizer applied at 1 lb N per 1,000 square feet on May 20th and August 1st, 2013.

	Days after initial fertilization									
Fertilizer	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days	70 days
	Relative quality (1 – 9 scale)									
Urea Gran	5.8 cd	5.5 cd	6.8 b	6.8 bc	6.5 ab	7.0 ab	6.8 ab	5.5 a	7.3 a	6.8 ab
Urea Liq	8.0 a	7.0 a	7.0 b	7.8 ab	6.0 ab	7.0 ab	5.5 b	5.8 a	6.3 a	6.0 ab
UMaxx	6.8 bc	6.8 a	7.0 b	7.8 ab	7.5 a	6.8 ab	7.0 a	6.0 a	6.8 a	6.5 ab
UFlexx	6.8 bc	7.3 a	8.3 a	7.5 ab	7.0 ab	7.3 ab	6.0 ab	6.0 a	7.0 a	7.0 a
Hydrexx	7.3 ab	5.8 bc	6.8 b	6.3 c	6.3 ab	7.0 ab	6.0 ab	5.8 a	7.0 a	6.5 ab
Instinct	6.0 cd	6.5 ab	7.8 ab	8.0 a	7.0 ab	7.3 ab	6.0 ab	6.3 a	6.0 a	6.0 ab
Harness	5.5 d	4.8 d	5.8 c	6.3 c	5.5 b	6.3 b	6.8 ab	5.8 a	6.5 a	6.3 ab
Nutrisphere	5.3 d	5.8 bc	7.0 b	7.5 ab	6.8 ab	7.5 a	7.0 a	6.3 a	6.5 a	6.5 ab
Stay–N	5.3 d	5.5 cd	7.3 b	7.0 abc	6.5 ab	6.8 ab	6.3 ab	5.5 a	6.5 a	5.8 b
Control	3.0 e	3.3 e	3.3 d	3.8 d	3.3 c	4.3 c	4.0 c	4.0 b	4.0 b	4.0 c
	Days after second fertilization									
	4 days	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days
	Relative quality (1 – 9 scale)									
Urea Gran	6.0 ab	5.8 c	8.0 a	7.5 a	7.3 ab	8.3 a	7.5 a	7.5 a	6.3 ab	6.5 ab
Urea Liq	5.8 ab	7.3 ab	7.0 a	6.3 b	6.3 bc	7.3 ab	7.0 a	6.3 bc	4.8 d	5.8 bc
UMaxx	6.3 ab	6.5 abc	7.8 a	7.5 a	6.8 abc	8.0 ab	7.8 a	6.0 c	6.0 abc	6.0 abc
UFlexx	6.3 ab	7.3 ab	8.0 a	7.8 a	7.8 a	7.8 ab	7.3 a	7.3 ab	6.5 a	6.8 a
Hydrexx	7.0 a	7.5 a	8.3 a	7.0 ab	7.0 abc	7.3 ab	6.8 a	6.8 abc	6.0 abc	5.8 bc
Instinct	6.3 ab	5.5 c	8.0 a	7.8 a	7.0 abc	7.8 ab	7.3 a	6.5 abc	5.3 cd	6.5 ab
Harness	6.8 ab	7.3 ab	7.3 a	6.3 b	6.0 c	7.0 b	6.8 a	6.3 bc	5.5 bcd	5.5 c
Nutrisphere	6.0 ab	6.0 bc	7.5 a	7.5 a	7.3 ab	7.3 ab	7.5 a	6.8 abc	6.0 abc	6.3 abc
Stay–N	6.0 ab	5.3 c	7.5 a	7.5 a	6.8 abc	7.3 ab	7.0 a	6.5 abc	5.8 abc	6.3 abc
Control	3.0 c	3.0 d	4.0 b	4.0 c	4.0 d	4.0 c	4.0 b	3.8 d	3.0 e	3.5 d

Within each rating date, means followed by the same letter are not significantly different from each other at alpha = 0.05.

All plots were 5 x 10 feet in size, and there were 4 replications of every treatment. Collected data included weekly relative color and quality (1 – 9 scale), weekly chlorophyll meter readings (using a hand held Spectrum Technologies chlorophyll meter), and monthly clipping yield.

Bentgrass – Field Trial

All fertilizer applied to the bentgrass as applied as liquids, with those materials applied using a backpack CO2 sprayer. This study consisted of a factorial design of N rate and N source, with all materials applied on May 20th 2013. N sources were urea liquid, Hydrexx and urea + Instinct, all applied at N rates of 0, ½, ¾ and 1 pounds of N per 1,000 square feet. The study was reapplied on August 1st. However, damage to the plots was severe due to turf burn and the second run of the study was abandoned.

All plots were 5 x 10 feet in size, and there were 4 replications of every treatment. Collected data included weekly relative color and quality (1 – 9 scale),

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Table 3. Relative color (1–9 scale) of Penn G–2 creeping bentgrass as affected by fertilizer additive and N rate, Auburn, AL 2013. There was never a significant N Rate x N source interaction, so main effects are shown. In all cases the N source is urea (except for unfertilized control plots), with all products applied as liquids. All N was applied on May 20th and Aug 1st. Plots not rated after second fertilizer application.

	Hours/days after initial fertilization											App 2
Additive	48 hr	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days	70 days	4 days
	Relative color (1 – 9 scale)											
Urea Liq	7.1 a	7.2 a	6.9 a	6.8 a	6.7 a	6.2 b	6.1 b	5.4 b	5.2 a	4.8 bc	4.0 a	1.8 b
Hydrexx	7.7 a	7.4 a	6.8 a	7.3 a	7.1 a	6.9 a	6.8 a	6.5 a	5.8 a	5.8 a	4.4 a	4.1 a
Instinct	7.2 a	7.0 a	6.3 a	7.0 a	6.8 a	6.5 ab	6.0 b	6.1 a	5.4 a	5.2 ab	4.3 a	1.7 b
Control	4.5 b	4.3 b	4.0 b	4.3 b	4.0 b	4.0 c	4.0 c	4.0 c	4.0 b	4.3 c	4.0 a	4.0 a
Hours/days after initial fertilization												App 2
N Rate (lb/M)	48 hr	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days	70 days	4 days
	Relative color (1 – 9 scale)											
0	4.5 b	4.3 d	4.0 d	4.3 d	4.0 c	4.0 c	4.0 c	4.0 b	4.0 b	4.3 c	4.0 a	4.0 a
0.5	7.1 a	6.3 c	5.6 c	6.0 c	6.1 b	5.9 b	5.8 b	6.0 a	5.2 a	4.8 bc	4.2 a	3.4 ab
0.75	7.2 a	7.2 b	6.7 b	7.0 b	6.5 b	6.6 ab	6.3 ab	5.9 a	5.6 a	5.4 ab	4.4 a	2.4 bc
1.0	7.7 a	8.2 a	7.7 a	8.1 a	8.0 a	7.1 a	6.9 a	6.1 a	5.7 a	5.7 a	4.1 a	1.8 c

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Table 4. Relative quality (1–9 scale) of Penn G–2 creeping bentgrass as affected by fertilizer additive and N rate, Auburn, AL 2013. There was never a significant N Rate x N source interaction, so main effects are shown. In all cases the N source is urea (except for unfertilized control plots), with all products applied as liquids. All N was applied on May 20th and Aug 1st. Plots not rated after second fertilizer application.

	Days after initial fertilizer application									App 2
Additive	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days	70 days	4 days
	Relative quality (1 – 9 scale)										
Urea Liq	5.0 ab	5.8 a	6.1 a	6.1 a	6.0 a	5.7 a	5.8 a	4.3 a	4.3 ab	3.8 a	1.5 c
Hydrexx	5.0 ab	6.0 a	6.0 a	6.7 a	6.3 a	5.7 a	5.7 a	4.5 a	4.5 a	4.3 a	3.3 b
Instinct	5.2 a	6.2 a	5.8 a	6.5 a	6.4 a	5.8 a	5.8 a	4.2 a	4.8 a	3.9 a	1.7 c
Control	4.5 b	4.0 b	4.3 b	4.5 b	4.3 b	4.0 b	4.0 b	3.8 a	3.8 b	3.8 a	4.5 a
	Days after initial fertilizer application										App 2
N Rate (lb/M)	7 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days	63 days	70 days	4 days
	Relative quality (1 – 9 scale)										
0	4.5 b	4.0 b	4.3 b	4.5 b	4.3 b	4.0 b	4.0 b	3.8 a	3.8 b	3.8 a	4.5 a
0.5	5.1 a	5.8 a	5.8 a	6.1 a	6.3 a	5.6 a	5.8 a	4.2 a	4.5 a	3.8 a	3.1 b
0.75	4.9 ab	5.8 a	6.0 a	6.4 a	6.1 a	5.6 a	5.8 a	4.3 a	4.4 a	4.0 a	1.9 a
1.0	5.2 a	6.3 a	6.1 a	6.8 a	6.3 a	6.0 a	5.7 a	4.5 a	4.7 a	4.1 a	1.5 c

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weekly chlorophyll meter readings (using a hand held Spectrum Technologies chlorophyll meter), and monthly clipping yield. Some of this data is not shown is this report, as we are still processing that data.

Laboratory Work

Ammonia Volatilization. To date, the ammonia volatilization experiments have consisted of one 7 day long experiment using a standard laboratory bench procedure for the evaluation of N loss via volatilization. For this first experiment treatments were: 1) granular urea, 2) urea + Stay N at 2 qt/ton, 3) urea + Stay–N at 4 qt/ton, 4) nutrisphere, and, 5) UFlexx. All fertilizers were applied at a rate of 1 pound N/1,000 square feet, with no additional water applied after application.

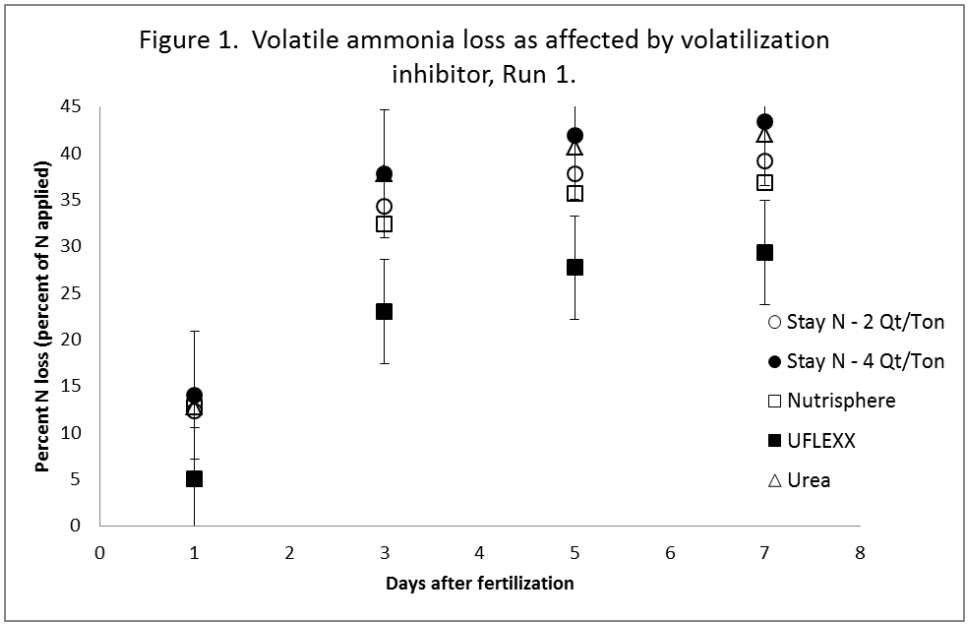
The volatilization system which will be used for all experiments consists of a series of 16 2–L glass canning jars, all attached to an air source via a 16–outlet manifold. A plug of turf (typically hybrid bermudagrass, is removed using a standard golf cup cutter, and it trimmed of all soil except a one inch layer). A plug is placed in each jar, the jar sealed, and air is allowed to flow along the top of the turf in each jar. This method collected ammonia via an ammonia trap system, following the method of O´Halloran (1993). Air flow is generated by passing 100 mL min–1 air stream through a 5N sulfuric acid air scrubber and across each jar, with

mg–N = mLs acid * N acid * 14 [1]
where 14 is the equivalent weight of N
and
% N volatilized = (total mg–N for each treatment/X) * 100 [2]
where X is the mg N per jar.

resultant NH3 trapped in 100 mL of 0.01 N boric acid. The boric acid trap is changed at various intervals (typically every other day for up to 15 days), with collected samples titrated to the original pH of the boric acid using 0.01 N sulfuric acid. Mass and percent of volatilized NH3 are calculated using the formulas:

For the study reported below, bermudagrass was harvested from fairway–type turf, with all but 1 inch of soil removed from the underside of each plug. Each plug was placed in a jar, and fertilizer added to the turf surface at a rate of 1 lb N per 1,000 square feet. No additional water was applied to the turf surface – a worst case scenario for volatilization. This experiment consisted of 4 fertilizer sources, each replicated 4 times. Long use of this experimental procedure has shown us that unfertilized turf and a bare (empty) jar have ammonia emissions numbers that are statistically zero.

Further volatilization will also be conducted, using various fertilizers and irrigation regimes.



Summary

Field Color/Quality Studies:

- Two warm–season 10 week long ´run–out´ studies have been completed on bermudagrass. One 10 week long ´run out´ study has been completed on bentgrass. A second bentgrass study will be initiated the second week of November, and a study on overseeded bermudagrass (Perennial ryegrass) will also be started in that same week. Thus, 5 of 10 field studies will be completed or initiated in 2012.
- Ammonia Volatilization Studies. We have clearly shown (and published data) that shows that 15–day trials are not needed, as the majority of N loss via volatilization occurs in the first 7 days. Thus, we will shorten many of our volatilization experiments to 7 days. The first product evaluation has been completed (results in this report), and the first irrigation study (irrigation water amounts) is currently in progress. Another irrigation study will be completed in November. Soils are currently being treated (to reach appropriate soil pHs) for the pH–volatilization studies.
- Incubation Studies. Incubation studies have not yet been started. These studies will be run in 2014, with duplicate incubation trials performed at several temperatures.

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